

EPA Review (June 11, 2018) of the Navy Response (May 25, 2018) to EPA Comments (May 2, 2018) on the Draft Technical Memorandum (April 17, 2018), Risk-Based Screening Level Assessment of Fixed Polonium-210 Activity Found on Bollards and Cleats [RTCs] at the Hunters Point Naval Shipyard, Hunters Point Shipyard, San Francisco, California
EPA's new June 11, 2018, comments in red

EPA's Overall Comments:

1. Even though the location of the bollards is currently not accessible to the public due to fencing and security controls, after property transfer, if current access restrictions are discontinued, then EPA still has concerns about potential public exposure. The exposure assumptions in the Navy's assessment do not appear to consider all reasonable potential pathways and receptors, as follows:
 - a. It is not reasonable to assume, as the Navy does, that only small children will be visiting the ship berth areas or other locations where metal structures are present and rusting. After transfer of property, in the long term, the ship berths location will be an open area for recreational use. Therefore, children of all ages will have access and it cannot be assumed that older children will not touch or climb on these structures. It also cannot be assumed, as the Navy does, that younger children will not touch or play with the structures while under the supervision of an adult.
 - b. Because this area of the shipyard is planned in the future to be open to the public, continued exposure risk for children and adults for all potential exposure routes, including ingestion, injection, and inhalation where the rusted and degrading structures are located should be considered in the risk evaluation. In addition, the current plans have not ruled out that the docks will be open to use by the public boats. This potential future use should be considered in the risk evaluation.
 - c. Assuming a single exposure event for an entire year for a recreational scenario, as the Navy has done, is not reasonable, especially since this area will be surrounded by residential housing. The six-year exposure duration for a child is standard risk assessment practice¹ and should not be considered unreasonable, as the Navy has, given the scope of the residential re-development in areas adjacent to the ship berths and also considering that the ship berths area will be open to public access as part of a shoreline recreational area.
1. The current risk analysis does not consider risk from injection of metal contaminated with polonium-210 (Po-210). The future condition of rusting metal structures at the shipyard could present an injection hazard, which could be caused by skin abrasion from the surface and/or small pieces/slivers of metal on or around the structures.

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U.S. EPA (1991a), U.S. Environmental Protection Agency (U.S. EPA), Human health evaluation manual, supplemental guidance: "Standard default exposure factors". OSWER Directive 9285.6-03.

2. The risk assessment conducted by the Navy only considered exposure to Po-210; however, risk assessments are required to consider all site-related contaminants of concern for a given exposure scenario. Laboratory data from the testing of metal material from a bollard at the site confirmed the presence of several radionuclides of concern (ROCs), including Cesium-137 (Cs-137) and Strontium-90 (Sr-90), which, based on analytical results, indicate are present above background levels and therefore may be considered site-related. (See Exhibit 13 Sample Analytical Results Summary from the Ship Berths 14, 21, 22, and 29 FSSR, for Survey unit 04.)

Path forward:

1. If the Navy wants to seek more evidence to support its position that the Po-210 is from naturally occurring sources, EPA recommends that the Navy consider collecting new samples with definitive laboratory analysis using an approved Quality Assurance Project Plan (QAPP) to ensure data are defensible and usable for decision-making. Using the definitive data, the Navy and EPA should conduct a collaborative scoping process about the exposure parameters for a risk evaluation that can be agreed upon by both parties.
2. Alternatively, for months, EPA has offered several options to resolve the issue:
 1. Remove the rust until the entire surface complies with the alpha activity release criterion and then paint the bollard. No need for repainting.
 2. Remove the entire bollards
 3. Paint the bollards and require in the O&M plan routine repainting if original paint has weathered.

Any of these is a relatively low-cost, quick way to protect public health and the environment. EPA's preference would be 1 or 3, because they remove any potential contamination from the Shipyard.

GENERAL COMMENTS

1. The Draft Technical Memorandum, Risk-Based Screening Level Assessment of Fixed Polonium-210 Found on Bollards and Cleats at the Hunter's Point Naval Shipyard (Memo) does not present a reasonable conceptual site model and assumptions regarding exposure scenario(s). The text of the Memo and Surface Preliminary Remediation Goal (SPRG) calculations include a number of assumptions in their assessment of risk due to the presence of Polonium-210 at the shipyard that are not fully supported and which do not meet the standard exposure scenarios included in EPA's 2011 Final Edition of the Exposure Factors Handbook, as indicated in the following comments.

Navy Response: *The use of the term 'conceptual site model' may be misleading in regard to the risk-based screening level assessment performed by the Navy. The purpose of the assessment was narrow and focused - to determine if Po-210 activity identified on bollards and cleats in Parcel D-1 poses an unacceptable risk to human health and warrants further investigation. The cited Exposure Factors Handbook (EPA, 2011) notes*

that the decision whether to use site-specific (or national) values for an assessment depends on the purpose of the specific assessment. As illustrated in Navy responses to the EPA comments that follow, the site-specific assumptions regarding the exposure scenario used to perform the screening level assessment have not been shown to be unrealistic.

EPA's evaluations of the Navy's responses are provided below.

2. **Exposure Conditions:** The first paragraph on Page 3 of 6 states that exposure via a skin abrasion or wound (i.e. injection of contaminated material) is negligible due to its potential for involving no more than a small amount of material. However, given the harsh environment of salt water and high humidity at the former Hunter's Point Naval Shipyard (HPNS) and the damp and rainy conditions in the San Francisco climate during the rainy season, it is expected that the existing metal bollards and cleats will continue to rust and degrade, resulting in surfaces that may contain sharp edges and flaking of metal/paint. As such, it appears plausible to consider exposure to a recreational receptor that includes injection of contaminated material from eroded surfaces at the shipyard. Injection should be included as an exposure pathway. Please include injection as an exposure pathway

Navy Response: *By design, bollards and cleats are fabricated with smooth, rounded surfaces to avoid damaging ropes used to moor ships in berth. The surface rust that occurs over time – as evidenced by the 60-year old bollards and cleats in Parcel D-1 - is not sufficient to create a puncture hazard of any significance. Paint flakes lack size and rigidity to present a credible puncture hazard or to involve more than a small amount of material. Therefore, there is no basis to include injection as an exposure pathway.*

As discussed in the Technical Memorandum Regarding Elevated Surface Alpha Activity in Appendix M [Appendix M] of the Draft Report Ship Berths 14, 21, 22, and 29 Final Status Survey Report (FSSR), July 2017 [Ship Berths 14, 21, 22, and 29 FSSR], the plate-out of Po-210 from sources of radon on outdoor metal structures is a recognized phenomenon that is readily observable primarily on galvanized metal surfaces or metal that is rusty, oxidized, or weathered. The sources of radon, however, cannot be confirmed and most likely are the result of both site-related radium-226 (Ra-226) sources as well as environmental sources. In addition, the identification of elevated concentrations of Lead-210 (Pb-210) in the metal from the laboratory analysis indicates that a secondary source of elevated concentrations of the Po-210 concentrations exists from the decay of Pb-210.

Furthermore, pictures of bollards provided in Appendix M clearly show the surfaces of the bollards are weathered, rusting, and have uneven/chipped surfaces. (Note that the effects of rusting can be observed on metal surfaces of commonly observed metal structures, such as bridges, cars, and older ships which are not maintained to prevent rusting, all of which demonstrate the destructive effects of rusting and breakdown of such structures.) As such, metal surfaces that are rusting at the shipyard can reasonably be expected to contain rough edges and result in the chipping or flaking of the metal surface due to the humid and rainy conditions that are common to the San Francisco area in the

rainy season. Further, the presence of electrolytes such as saltwater and other acidic substances are known to accelerate the rusting and degradation process, so for structures such as the bollards, which are near the saltwater in the Bay, the degradation will occur at a greater rate. Therefore, the future condition of rusting metal structures at the shipyard could present an injection hazard caused by skin abrasion from the surface and/or small pieces/slivers of metal on or around the structures.

3. **Exposure Conditions:** The Memo does not take ongoing oxidation (rusting) into account. The second paragraph on Page 3 of 6 states that a reasonable and most likely scenario for the release of the fixed Polonium-210 (Po-210) activity would be surface grinding in preparation for painting the bollard or cleat; and that an activity such as this would not occur incidentally or as a recreational activity. However, environmental conditions at the HPNS are such that metal surfaces of bollards and cleats will continue to be oxidized. This oxidation will degrade and disintegrate the surface of such objects. The disintegration of such surfaces results in the generation of particles and pieces of such metal becoming available for deposition on or around such surfaces similar to the scenario where the surface is mechanically ground. The Draft Report Final Status Survey: Ship Berths 14, 21, 22, and 29, July 2017, Appendix M, Technical Memorandum Regarding Elevated Alpha Surface Activity dated September 23, 2014 (Appendix M) states “elevated alpha activity has been found consistently on or near heavily weathered (i.e., rusted) metal surfaces.” This information indicates the elevated alpha activity, attributed primarily to Po-210, is widespread throughout the shipyard area where metal objects are located; this is a different exposure scenario than presented in the Memo. Please include ongoing natural degradation and disintegration of the metal surfaces of bollards and cleats with associated generation of particles and pieces of metal as an exposure condition.

Navy Response: While elevated alpha activity, attributed primarily to Po-210, may be found on or near heavily weathered (i.e., rusted) metal surfaces throughout the shipyard, smear samples collected indicate the alpha activity is fixed and not removable. The ongoing natural degradation and disintegration of the metal surfaces – as evidenced by 60-year old bollards and cleats in Parcel D-1 - does not result in the generation of particles and pieces of metal in the nature of removable activity. In addition, even if oxidation resulted in removable alpha activity, it would be a slow process over time relative to the much more conservative assumption of surface grinding occurring as a single event. Therefore, there is no basis to include ongoing natural degradation and disintegration of the metal surfaces of bollards and cleats with associated generation of particles and pieces of metal as an exposure condition without some form of mechanical surface abrasion, such as grinding as presented in this tech memo.

The pictures provided in Appendix M of the Ship Berths 14, 21, 22 and 29 FSSR appear to depict a bollard that has missing pieces from the surface that have chipped off from the rusting and degradation of the surface. Therefore, it appears reasonable to assume some chipping/flaking of the metal surface will continue in the future and at a quicker rate for structures close to the Bay.

4. **Exposure Events:** A single exposure event is not a likely scenario. The Memo states that multiple exposure events were not considered credible because it was assumed to be unlikely that loose radioactive material on the ground would remain in place in any significant concentration over multiple days due to the wind and rain that are common to the area. A single ingestion event resulting in an internal radiation exposure is assumed in the SPRG calculation presented in the Memo. However, the assumption that there would be only a single exposure scenario does not meet the expectation for reasonable consideration for the recreational scenario for either a child or adult. Given that residential housing is planned nearby, it is likely that the nearby residents will visit the shoreline of the shipyard area for recreational purposes on multiple days within any given year. Also, it only rains for part of the year; during the dry season, rusty particles would accumulate. In addition, Appendix M indicates the elevated alpha activity detected at the shipyard areas, attributed primarily to Po-210, is widespread throughout the shipyard area where multiple exposures could occur in a single day. Multiple exposures should be considered credible and incorporated into the risk calculations. Please incorporate multiple exposures into the risk calculations.

Navy Response: *The intent of this risk assessment is to look at the most conservative and realistic exposure scenario. It is important to note that contamination was not removable; future exposure is tied to maintenance of the bollard that would include sanding or grinding. For modeling purposes, a small child was assumed to represent the maximally exposed individual. An outdoor worker or adult recreational visitor could also be selected. However, neither was selected because of the single behavior critical to exposure via the ingestion pathway – that of transferring contaminated material from the surface to the mouth via the hand. Children routinely touch surfaces and put their hands in their mouths. Adults do not. Multiple exposures are credible for an adult in the nature of a repetitious behavior – such as sitting on or near a bollard day after day and gazing at the Bay, but an adult would not crawl and play on a grit-covered surface around a bollard for hours and repeatedly put their hand to into their mouth. It is not a realistic scenario that an unattended child would be playing on the ground around a bollard that had just been sanded to remove rust over several days. Therefore, unless the maximally exposed individual is changed from a child to an adult, there is no basis to incorporate multiple exposures into the risk calculations.*

The assumption that the metal surface is not removable from bollards and other metal structures at the shipyard is not a reasonable expectation given the pictures provided in Appendix M that show the bollard surfaces are chipped and degrading, or given the highly oxidizing environment in which the metal structures are located. Further, it is reasonable to assume it is highly likely that older children will touch or climb on the existing structures and therefore be at risk for ingesting flaking material, or receiving a metal sliver that punctures the skin from these structures. Further, since the reason Po-210 is being sequestered on these structures is that the metal is oxidizing/rusting, it is reasonable to project that some flaking of the metal itself, not just the paint, has, and will continue to occur.

5. **Exposure Events:** The risk from exposure to a radiation hazard cannot be compared to the potential risk from drowning. The Memo states that risk to the dose receptor, i.e., an unattended child near the water's edge, posed by drowning far exceeds and effectively negates the incrementally increased risk posed by the radiation hazard. However, the comparison of risk from ingestion of radioactive material to risk posed by drowning of an unattended child has no bearing on a statutory determination of whether a release of a hazardous substance, such as exposure to a one or more radionuclides may result in a risk greater than $10E-06 - 10E-04$ excess lifetime cancer risk (ECLR). The statutory mandate regarding the assessment of risk due to the release of a hazardous constituent is promulgated by the National Contingency Plan (NCP) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 40 CFR 300.430(e). Please delete the comparison to risk associated with drowning from the Memo.

Navy Response: While the absolute human risk presented by a hazard may be the same regardless of context, the statutory mandate cannot be applied properly without rational consideration of real-life constructs. In other words, the location of the hazard, whether in deep sea, deep space, or in a neighbor's backyard, does have bearing on the context within which it is considered. The bollards and cleats in Parcel D-1 are, by design, installed next to deep water ship berths which have no fencing or other protection from fall and water hazards. The radiation hazard must be assessed in the context within which it is found - a small child playing unattended at the edge of a ship berth. Therefore, removing the comparison to the greater risk associated with drowning is not appropriate.

It is reasonable to consider the location and constructs of the area where the hazard is located; however, it appears the author assumes that only small children will be visiting these areas where the metal structures are located and as such will prevent or restrict access, thereby limiting potential exposure routes. It is not reasonable to assume that only small children will be visiting these areas. Since the ship berths will be an open area for recreational use, children of all ages will have access and it cannot be assumed that older children will not touch or climb on these structures. It also cannot be assumed that younger children will not touch or play with the structures while under the supervision of an adult. Furthermore, because this area of the shipyard will be open to the public, continued exposure risk for children and adults for all potential exposure routes, including ingestion, injection, and inhalation where the rusted and degrading structures are located should be considered in the risk evaluation. In addition, it is not known whether the docks will be open to use by private boats. This potential future use should be considered in the risk evaluation unless it is known that the ship berths area will be restricted from such use by the public.

6. **Source Term:** The source term should be based on laboratory results, not the gross alpha surface scan. The source term is assumed to be composed of Po-210 equivalent to an average concentration of 200 disintegrations per minute (dpm) per 100 square centimeters (cm^2) distributed on the ground in a 5 square meter (m^2) area around the bollard or cleat. The average concentration of 200 disintegrations per minute (dpm) per 100 square centimeters is based on a gross alpha survey of the surface. However, a gross

alpha measurement significantly underestimates the amount of radioactivity present due to the short distance and shielding involved in the metal structure itself, and represents the low-end of the measured range of the 200 to 400 dpm/100 cm². Therefore, only the destructive laboratory analysis should be relied on to estimate the amount of radionuclides present in the rust material. Appendix M reported the following detections of radionuclides: Beryllium-7 (Be-7) at 2.821 picoCuries per gram (pCi/g); Lead-210 (Pb-210) at 9.876 pCi/g; Pb-214 at 0.328 pCi/g; and Po-210 at 19.743 pCi/g. Please use laboratory data to estimate the amount of radionuclides present.

Navy Response: *The sample of surface material was collected to provide qualitative information regarding the nature of the elevated alpha activity; i.e., to identify the source radionuclide of the elevated alpha activity. The laboratory results showed 80 percent of the alpha activity to be Po-210. As a measure of conservatism, the screening level risk assessment assumed 100 percent of the alpha activity to be Po-210, which is the limiting radionuclide from a risk perspective. Information that would be necessary to apply the results quantitatively is missing. For example, the exact size of the surface from which the sample was collected is not known. Neither are the thickness of the surface layer that was removed and the collection efficiency of the grinding process. Therefore, the laboratory data cannot be used to estimate the amount of radioactivity present in terms of radionuclide concentrations over a given surface area (i.e., dpm/100 cm²).*

EPA agrees that the data presented in the Ship Berths 14, 21, 22, and 25 FFSR are not sufficient to provide definitive information about the concentrations over a given surface area; however, the comment was generated in the event that the Navy had access to the original data packages that provided all of the necessary information to provide such a calculation. As the Navy responses confirmed that the sample that was analyzed was not contained in a hermetically sealed container and held for the 21-day ingrowth time, the existing laboratory data cannot be relied on to make decisions regarding the concentrations of ROCs on the bollards.

7. **Source Term:** A single exposure event is unrealistic. The Memo reports that based on their assumptions and radionuclide concentration inputs in the SPRG calculator, the Surface PRG for ingestion of Po-210 is 0.163 Becquerels per square centimeter (Bq/cm²), which converts to 978 disintegrations per minute (dpm)/100 cm² (using the conversion factor of 1 Bq/cm² = 6,000 dpm/100 cm²) at a target cancer risk of 1 x 10E-06. The Memo also states that the calculated ingestion SPRG for Po-210 (978 dpm/100 cm²) is significantly higher than the source term concentration assumed for this exposure scenario of 200 dpm/100 cm²) and using the 200 dpm/100 cm² value results in an equivalent cancer risk of 2.0 x 10E-07. However, the Surface PRG value and associated risk are based on an assumption of a single exposure event (i.e., 4 hours for 1 day per year) to an adult worker, with minor modifications made to the calculation to account for a child. These assumptions are very limiting and do not meet the expectations of a realistic scenario based on an agreed upon conceptual site model nor do such assumptions meet the intent of risk evaluation under CERCLA and the NCP. A more realistic scenario based on multiple exposures is needed. Please use a more realistic scenario that includes a child playing along the shoreline for 250 days per year for six years, which is

the typical scenario used for child exposure in risk assessments.

Navy Response: *The assumption of a single exposure event that occurs over a four-hour period on a single day is based on the selected exposure scenario – grinding the surface of a bollard or cleat in preparation for painting followed by a small child playing unattended on the ground around a bollard or cleat near the water’s edge. As discussed in the Navy response to Comment #4, a scenario involving multiple exposures is credible for an adult, but not for a small, unattended child. As noted in the Navy response to Comment #3, the nature of the source term is activity fixed to the metal surface. To become available for intake, i.e., as loose material on the ground around the bollard or cleat, some form of mechanical surface abrasion, such as grinding, is required. Since the available source term is not self-perpetuating, a simple test – spreading flour on the ground around a bollard or cleat – would quickly reveal that it is not reasonable to assume that the source term remains undisturbed and available for intake over a six-year period due to daily wind conditions and seasonal rain that are common to the area. Therefore, a scenario that includes a child playing along the shoreline for 250 days per year for six years - while it may be the typical scenario used for child exposure in risk assessments in a residential area - is not realistic for the selected exposure scenario.*

Superfund site risk assessments may be constructed on site-specific parameters based on what is considered reasonable given site conditions, the contaminants of concern, and other pertinent parameters affecting the exposure scenario. For instance, the Oak Ridge National Laboratory (ORNL) Risk Assessment Information System (RAIS) includes an assumption of exposure to a recreator of 75 days per year. In this case, assuming a single exposure event for an entire year for a recreational scenario is not reasonable especially since this area will be surrounded by residential housing. Assuming a six-year duration for a child is standard practice and should not be considered unreasonable, given the scope of the residential re-development in areas adjacent to the ship berths and also considering the ship berths area will be open to public access as a recreational area.

8. **Source Term:** It is unclear why all detected radionuclides were not included in risk calculations. The Tech memo states that for modeling purposes, the source term also is assumed to include Po-210 progenitors bismuth (Bi)-210 and Pb-210, both of which are beta emitters, and all in secular equilibrium. This is consistent with the sampling results, which found near equal concentrations of both gross alpha and gross beta activity. However, the Tech Memo does not provide information about the concentrations assumed for Bi-210 and Pb-210 (i.e. the branching ratios used), therefore the information in the Memo is incomplete. Appendix M reports activity from the bollard composite sample collected in 2014 as follows: Beryllium-7 (Be-7), at 2.821 pCi/g, Potassium-40 (K-40) at 2.248 pCi/g, Cesium-137 (Cs-137) at 0.947 pCi/g, Lead-210 (Pb-210) at 9,876 pCi/g, Pb-214 at 0.328 pCi/g, Po-210 at 19.743 pCi/g, and Strontium-90 (Sr-90) at 0.519 pCi/g, yet the Memo does not explain why some of these radionuclides were not included in the SPRG calculations. It is understood that environmental radionuclides such as K-40 do not need to be included in the calculation of risk, but it is not clear why radionuclides of concern (ROCs) for the ship berth areas (i.e., Cs-137 and Sr-90), as well as Pb-214 (progenitor to Po-210) were not included. To estimate risk, all ROCs should

be included in the SPRG calculation. Please use all detected ROCs in the risk calculations and provide the concentrations assumed for Bi-210.

Navy Response: *The screening level risk assessment was performed specifically to determine if Po-210 activity identified on bollards and cleats in Parcel D-1 poses an unacceptable risk to human health and warrants further investigation. Consequently, only Po-210 and its immediate progenitors Pb-210 and Bi-210 were considered. The assessment assumes the three radionuclides are in equal concentrations under secular equilibrium. Therefore, based on the purpose of the assessment, including all detected radionuclides of concern in the assessment is not appropriate.*

On the contrary, a risk assessment is required to consider all site-related contaminants of concern. In fact, a more thorough analysis should have added risk from chemical exposure, but EPA's estimated risk from radiological exposures alone already exceeded the risk range in the National Contingency Plan. Laboratory data from the testing of a metal material from a bollard at the site confirmed the presence of several ROCs. Furthermore, in Exhibit 13 (Sample Analytical Results Summary from the Ship Berths 14, 21, 22, and 29 FSSR, for Survey unit 04), soil concentrations for Cs-137 ranged from non-detect (around 0.04 pCi/g) to 0.143 pCi/g. Sr-90 results were mostly non-detects (around 0.126 pCi/g), but with one maximum concentration at 0.198 pCi/g, and another subunit maximum concentration of 0.326 pCi/g. However, subsequent analyses at the location of the initial reported concentration of 0.326 pCi/g were all non-detects. Therefore, the concentrations of Cs-137 and Sr-90 in the bollard sample indicate elevated concentrations above background, so both radionuclides should be included in the risk assessment.

9. **Source Term:** The Memo does not consider that the elevated Minimum Detectable Concentration (MDC) reported for Ra-226 and Bismuth-214 (Bi-214) and the detection of Pb-214 and Pb-210 indicate that Ra-226 was likely present below the MDC. The Memo states the presence of Po-210 cannot be attributed to legacy Navy radiological operations because its progenitor Ra-226 (1,600 years) and Po-210 would have reached secular equilibrium many years ago and parent/progenitor radionuclides would be present in comparable concentrations, which they are not. The text also states no other alpha-emitting radionuclides, including Ra-226, were detected in the analysis of the sample collected from the metal surfaces. However, Appendix M reports the detection of Pb-214, a decay product of Radium-226 (Ra-226) at 0.3 pCi/g, which indicates that Ra-226 was actually present. In addition, the MDCs reported for Ra-226 and the other main gamma and alpha-emitting daughter product, Bi-214 are elevated at 1.372 pCi/g and 2.089 pCi/g, respectively. The elevated MDCs and the detection of Pb-214 indicate Ra-226 was most likely present but not reported as detected due to the elevated MDCs for Bi-214. Further, if the sample was not sealed and allowed to equilibrate for 21 days, then a large percentage of the radon gas may have been lost, resulting in artificially lower reported concentrations or non-detect results for Bi-214, Pb-214, and Ra-226. Further, since the Po-210 is present in elevated concentrations on the metal structures due to the plating out of this radionuclide from the decay of radon, Po-210 is ultimately present due to the presence of Ra-226, and current information presented in the Memo regarding the

source of Ra-226/radon-222 is not sufficient to determine whether the source of Ra-226 is environmental or contamination at the site or on the bollards. Finally, there is data that indicates that radon-222 is not present at high concentrations in the Bayview Hunters Point area. None of 7 tests in the 94124 zip code resulted in detection of radon above 4 pCi/liter (<http://www.city-data.com/radon-zones/California/California.html>). Please revise the Memo to acknowledge that the source of Po-210 is likely radium paint that was used on the bollard in the past. Also, please revise the Memo to acknowledge that due to the detection of Pb-210 and Pb-214 and the elevated MDCs for Ra-226 and Bi-214, Ra-226 was likely present in the sample. Finally, please revise the Memo to acknowledge radon 222 is not present at high concentrations in the Bayview Hunters Point vicinity.

Navy Response: *It is recognized that Ra-226 may be present in the sample at a concentration below the MDC. Even if Ra-226 is present at the reported MDC of Bi-214 (1.12 pCi/g), it does not explain the presence of Po-210 at a concentration nearly 20 times higher. This point is particularly important considering the half-life of Ra-226 is 1,600 years while the half-life of Po-210 is only 140 days. There must be a relatively constant feeder source for the Po-210, such as could be provided by radon in the environment, to sustain its presence at that concentration, particularly given its relatively short half-life. It is also important to note that this is not an isolated observation at Hunters Point but it has been noted on other surfaces in the shipyard as reported in the North Pier FSSR. The MDCs for Ra-226, Bi-214, and Pb-210 fall in the range of 1.1 to 2.3 pCi/g, which is several times higher than the MDC for Pb-214, which is 0.3 pCi/g. Still, this does not support the contention that the source of the Po-210 is radium paint or other Navy legacy activity. Po-210 was detected at a concentration of 19.7 pCi/g. In equilibrium, Pb-214, Bi-214, and Pb-210 would be found in similar concentrations. They are not. Pb-210 is reported present at 9.9 pCi/g. If in secular equilibrium, then other radionuclides would be found in similar concentrations. They are not. The argument of elevated MDCs masking the presence of Ra-226 may be true provided its concentration falls in the range of 1-2 pCi/g. Since the sample was not hermetically sealed and allowed to equilibrate, the results cannot be used to infer the concentration of Ra-226 anyway. Regardless, the argument is not relevant in regards to the origin of the Po-210. The concentration of radon-222 in the environment is not relevant to the screening level assessment. With a 22 year half-life, radon .*

It is agreed that due to the short half-life of Po-210 of 140 days, there may be an ongoing source of radon that is contributing to the sequestering and concentration of Po-210 by the iron oxides in the metal structures at the site. However, there does not appear to be a way to determine how much of the radon at the site is due to environmental sources and how much is due to the presence of paint or other site-related sources of Ra-226 on or near the bollards, which is contributing to the accumulation of Pb-210 and Po-210, without further analysis. It would be useful to collect at least three or more new samples and analyze them in a laboratory using an approved QAPP to ensure results are definitive and usable for decision-making.

It appears that the final sentence in the response is incomplete.

10. **Risk:** The risk to a child receptor is unacceptable if the bollards and metal surfaces are not remediated to mitigate potential exposure. The Memo reports on the results from the SPRG calculations used to identify an ingestion preliminary remediation goal for Po-210 based on an assumed concentration derived from a 200 dpm/cm² alpha survey of a metal bollard for a worker scenario, with some noted exceptions to the default parameters. It is noted that the SPRG calculation assumes the contaminated media is dust. An independent SPRG calculation was performed using the worker exposure scenario with the exception that some exposure parameters were modified where deemed appropriate to more closely simulate a child recreator scenario at the HPNS. These modifications include the following: an exposure duration of 6 years, 250 days, 4 hours per day; a hand to mouth transfer frequency of 10; a finger surface area of 16 cm²; contamination /exposure surface area of 100 m², and using the San Francisco climate zone. Concentrations obtained from Appendix M in pCi/g were converted to units of pCi/cm² by assuming a density for rusted metal of 5.12 g/cm³ and an assumed combined dust particle surface area of 1 square millimeter for ingestion to obtain concentrations in pCi/cm². The results of this calculation indicate that the ingestion PRG for the five radionuclides included in the analysis are as follows: Cs-137 – 0.655 pCi/cm²; Pb-210 – 0.00102 pCi/cm²; Pb-214 - 0.00102 pCi/cm², Po-210 – 0.00145 pCi/cm², and for Sr-90 – 0.355pCi/cm². The risk to the child recreator using these assumptions is equal to:

Radionuclide	Ingestion PRG (pCi/cm ²)	Ingestion Risk
Cs-137	7.4E-07	4.9E-08
Pb-210	4.95E-04	1.4E-04
Pb-214	1.64E-05	4.67E-06
Po-210	6.97E-04	1.32E-04
Sr-90	7.5E-07	1.04E-07
Total Risk		1.21E-03

Using the source term and site-specific exposure parameters listed above, the total risk from the intake of dust/metal particles contaminated with Cs-137, Pb-210, Pb-214, Po-210, and Sr-90 is estimated to be 1.21E-03. This calculated risk exceeds the risk range of 10E-04 to 10E-06. Therefore, based on this analysis, all metal structures and areas surrounding these structures will require some type of remediation to mitigate the unacceptable potential risk to the future recreator child or adult. Please revise the Memo to include this information and discuss a path forward for mitigating the risk posed by metal structures/surfaces at the ship yards.

Navy Response: *The assumptions stated above have no merit. Specifically, an exposure duration of 6 years, 250 days, 4 hours per day is unrealistic because the activity is fixed. A finger surface area of 16 cm² is closer to the size of an adult's largest finger. A contamination /exposure surface area of 100 m² far exceeds the surface area of any single bollard. Assuming a density for rusted metal of 5.12 g/cm³ is inconsistent with contamination in the form of dust. As illustrated by the Navy responses to the preceding EPA comments, site-specific assumptions made by the Navy are sufficiently conservative. Therefore, there is*

no basis to conclude that the Po-210 found on the bollards and cleats in Parcel D-1 poses an unacceptable risk to human health and warrants further investigation.

EPA suggests considering a collaborative scoping process about the exposure parameters for a risk evaluation that can be agreed upon by both parties.